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Pore network characterisation of shrub fabrics from the Ballık area, Denizli, western Turkey.

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In 2006 the Tupi oil field (now Lula oil field) was discovered offshore Brasil, with microbial carbonates acting as reservoir rocks. Similar reservoir discoveries, both on the east coast of South America as well as offshore West Africa, resulted in an increased interest in these microbial carbonates. Several of the observed fabrics are widely recognized in travertine and tufa settings, among them so called "shrubs". In a continental carbonate context the term is reserved for morphological shrub-, fern- or bushlike arborescent growths that branch upward to form colonies, resembling miniature forests, on a centimetre scale or smaller. The extent of the bacterial influence on these travertine fabrics is still under discussion. It is however generally accepted that microbial growth provides environmental conditions and nucleation sites favouring shrub precipitation, that itself can vary from microbially controlled to abiotic. The fast decay of the bacteria also has its implications for the diagenesis of the fabrics, leading to very micro-porous structures. While the sedimentological and diagenetic history of these fabrics thus have been subject to several studies, until present no petrophysical data have been reported. This study integrates observations from classical petrography, fluorescence and Scanning Electron Microscopy (SEM) with results from Water Saturation (WS), Mercury Injection Porosimetry (MIP) and Computer Tomography (CT).

Based on occurrence site, four main types of shrubs can be distinguished in the Ballık area (Denizli, SW Turkey). The first three types are observed (1) at the edges of primary caves, (2) as a rim surrounding macrophyte moulds, and (3) as patchy distributed solitary shrubs. Macroscopic white shrub crusts that consist of organic rich dendritic micrite solidified by sparites (4) however are the dominating shrub type. They are found as major fabric of a subhorizontal facies, possibly precipitated in shallow lakes, laterally extending over more than 300m and exceeding 10m in thickness. Consequently the white shrub crusts form the focus of this study.

Fluorescence microscopy on fluorescent dye impregnated thin-sections indicate a distinct presence of microporosity. These micropores are confirmed by SEM and seem to result from the decay of bacteria (µm size) and their filaments (up to 100µm in size). They form a complex framework for which connectivity on sub-shrub scale seems excellent, while between shrubs it depends on sparite occurrence, shrub density and size. Micro CT scans (<3µm resolution) were executed to reconstruct the 3D pore network and to evaluate the size, shape and connectivity of the pores in 3 dimensions. The reconstructed pore network is subsequently subjected to permeability simulations. The combination of CT, WS and MIP indicates that the observed micropores represent a distinctive share in the total porosity, and should not be neglected from a reservoir characteristics point of view.